

**Unofficial Submission - Draft of Request for Interview
(Eleventh Page of Sixteen Pages)**

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LOSSES IN MAGNETIC CORES

[Ch. V]

to 20,000 gaussses, the loss decreases and rapidly approaches a small value as indicated by the curves of Fig. 2. When the flux varies in magnitude as well as in direction, the loss is less than that occurring when the flux variation is only rotational with the same value of maximum flux density. In the usual type of electrical machine, a relatively small part of the loss occurs in the iron subjected to the rotating field, and the error produced through using the losses computed for an alternating field is therefore generally not large.

2. EDDY-CURRENT LOSS AND SKIN EFFECT

Whenever the magnetic flux in a medium is changing, an electric field appears within the medium as a result of the time variation of the flux. The line integral of this electric field $\mathcal{E}$ taken around any closed path that bounds the flux is given by the Faraday induction law as

$$\oint_{abcd} \mathcal{E} \cdot d\ell = -d/dt \int \mathcal{B} \cdot n \, ds \quad [14]$$

where $abcd$ is the circuital path bounding the area crossed by the flux φ or $\int \mathcal{B} \cdot n \, ds$. When the medium is conducting, a current* is set up around this path by the induced electromotive force ϵ resulting from the line integral of the electric field. These currents are called *eddy currents*. Their presence results in an energy loss in the material proportional to $i^2 R$, called *eddy-current loss*, the energy being absorbed from the circuit that sets up the field and being dissipated as heat in the medium.

Since the flux density in ferromagnetic materials is usually relatively large, and since the resistivity of the materials is not extremely large, the induced electromotive forces, the eddy currents, and the eddy-current loss may become appreciable if means to minimize them are not taken. This loss is of considerable importance in determining the efficiency, the temperature rise, and hence the rating, of electromagnetic apparatus in which the flux density varies.

To illustrate the conditions typical of those that occur in an iron core, the thin metal slab shown in Fig. 4 is considered to be permeated by an alternating flux φ . From Eq. 14, the electromotive force ϵ induced around a boundary $abcd$ of an area through which a flux is changing is given by

$$\epsilon = - \frac{d\varphi}{dt} \quad [15]$$

This voltage acting around the circuit $abcd$ causes a current i to circulate around the boundary and to set up a magnetomotive force in such a

* Displacement currents are not considered in this analysis, since their effects are here negligible.

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EXHIBIT C (SECOND PAGE OF THREE PAGES)

PRINCIPLES OF
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SERIES

Magnetic Circuits and Transformers.

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By Members of the Staff of the
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EXHIBIT C (THIRD PAGE OF THREE PAGES)



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